CLAIMS

What is claimed is:

1. A method for monitoring material properties comprising:
mounting an electromagnetic sensor on a test material surface; and
periodically measuring at least one electrical property of the material under the sensor footprint.

2. A method as claimed in Claim 1 where the sensor is an eddy-current sensor.

3. A method as claimed in Claim 1 where the sensor is a conformable spatially periodic field eddy-current sensor.

4. A method as claimed in Claim 3 where the sensor has a periodic primary winding to excite a periodic magnetic field and at least one sensing element to detect variations in the magnetic field related to electrical properties of the material under test.

5. A method as claimed in Claim 4 where multiple sensing elements are used to measure absolute electrical conductivity at each sensing element location with at least one primary current excitation frequency.

6. A method as claimed in Claim 5 where at least one sensing element is located in a region expected to see less damage than at other elements.

7. A method as claimed in Claim 6 where the sensing element at the location of less damage is used as a reference for measurements at other elements.

8. A method as claimed in Claim 1 further comprising intentionally varying the temperature of the material under test to verify the proper performance of the sensor.

9. A method as claimed in Claim 1 further comprising intentionally varying the temperature of the material under test, recording the temperature variations with a temperature measurement sensor, and recording the sensor data at a plurality of temperature levels.

10. A method as claimed in Claim 9 further comprising calibrating the sensor using the sensor data at different temperatures.

11. A method as claimed in Claim 9 further comprising assessing the test material condition using sensor data at multiple temperatures.

12. A method as claimed in Claim 1 further comprising measuring the electrical property at specified times.

13. A method as claimed in Claim 12 further comprising using a change in the electrical property above the noise level to indicate a significant change in the test material condition.

14. A method as claimed in Claim 1 further comprising mounting the sensor with a gap between the sensor and the test material to permit the environment under the sensor to substantially match the environment if the sensor was not present.

15. A method as claimed in Claim 1 further comprising perforations in the sensor to allow corrosion to occur at the test material surface.

16. A method as claimed in Claim 1 further comprising providing guides to permit scanning eddy-current sensors to inspect with the permanently mounted eddy-current sensor remaining in place.

17. A method as claimed in Claim 1 further comprising a mechanism to permit relative motion of the sensor windings relative to the test material using a remote actuation.

18. A method as claimed in Claim 3 further comprising shaping the test material to create a stress distribution so that fatigue damage initiates under the sensor.

19. A method as claimed in Claim 18 where the test material is formed into a dogbone shape and the center section is thinned to localize fatigue damage.

20. A method as claimed in Claim 19 where the test material further comprises reinforcement ribs on the edges.

21. A method as claimed in Claim 20 where the test material further comprises radius cutouts on both sides of the thinned section.

22. A method as claimed in Claim 18 where the test material further comprises radius cutouts on both sides of the thinned section.

23. A method as claimed in Claim 1 where the sensor is conformable.

24. A method as claimed in Claim 1 where the sensor is a dielectrometer.

25. A method as claimed in Claim 1 where a second sensor is incorporated with the electromagnetic sensor.

26. A method as claimed in Claim 25 where the second sensor is a strain gauge.

27. A method as claimed in Claim 25 where the second sensor is a temperature gauge.

28. A method as claimed in Claim 1 where the sensor comprises a drive conductor to carry an applied electric current and at least one sensing element to measure the electrical properties of the material under test.

29. A method as claimed in Claim 28 where the sensing elements are absolute inductive coils.

30. A method as claimed in Claim 28 where the sensing elements are magnetoresistive elements.

31. A method as claimed in Claim 28 where the sensing elements are SQUIDS.

32. A method as claimed in Claim 28 where the sensing elements are differential inductive coils.

33. A method as claimed in Claim 1 where measurement grids are used to convert the sensor response to one or more properties of interest.